SOME CONSIDERATIONS ABOUT THE URBAN SPRAWL PROCESS

IN SPAIN AND MEXICO

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Abstract: This paper pretends to make some reflections about the urban sprawl process in the metropolitan areas in Spain[2] and Mexico[3]. The use of technologies related to satellite imagery (remote sensing) allows the characterization of the phenomenon of consumption, pathological or not, of land. And this analysis suggests some hypothesis about the plurality of contemporary of urbanization processes. Roughly two models stand out: one based urban development at low densities, where the unsustainable consumption of land is presented as a paradigm of economic development and, another hand, an urban development with a compact city model, where recycling land, and not just increasing the consumption of land, is one of the key objectives of urban policy. The work presented here, suggests that in recent years appears a change in the paradigm towards a more efficient and sustainable use of the territory.

Key words: urban sprawl, diffuse city, sustainable city, land consumption, Spain, Mexico.

1. - Introduction

The second half of the twentieth century was undoubtedly the time when there has been a faster urban growth worldwide. The urban population has grown from 750 million in 1950 to 2860 millions in 2000, and now represents over 50% of world population. Spain and Mexico have been no

[1] The paper is within one of the research lines in the PhD Program in Urban Management and Valuation of the Polytechnic University of Catalonia (UPC, Center of Land Policy and Valuations).

[2] The data in this paper, referring to Spain, coming from two different sources of information: on the one hand the the data bases of the CORINE Land Cover project in the European Union, and secondly the results of several research projects developed by the Center for Land Policy (CPSV) of the UPC. Specifically, the research project, funded by the Ministerio de Ciencia e Innovacion, The process of urbanization in the Mediterranean: Towards a model of sustainable land use?. A retrospective analysis (1956-2006) and prospective (2006-2026) (2006-2009), as well as the project The evolution of 20 urban landscapes in the last 50 years, funded by the Ministerio de Vivienda (2007-2008).

[3] The data source for Mexico, comes from the data bases from INEGI and from the study made by SEDESOL, CONAPO and INEGI, Delimitacion de las Zonas Metropolitanas de Mexico, 2005.

exception. The urban transformation generated in both countries is a phenomenon of great magnitude. In the mid-twentieth century, both Spain and Mexico were basically countries with an agricultural profile. Over 50% of the two countries population worked in agriculture. At the beginning of the twenty-first century, however, less than 20% (10% in Spain) of the employed population is engaged in agricultural activities. Industry but above all, services represent the majority of jobs.

Following the great ecologist Ramón Margalef, there has been a real inversion in the topology of the landscape. Highway networks, which only a few decades before were isolated elements throughout the countryside, are now present throughout the territory, setting a new "landscape". Landscape in which the rural become "islands" throughout the highly urbanized land, and this change has occurred in the course of one generation. Women and men born in 1950 have seen witness to the extent of the changes. Change that from the 70s has been characterized not only by the progressive development, but by the continue increase in per capita consumption of land: this process has been called urban sprawl.[4]

It is true that the urban sprawl, the process of gradual spread out of urbanization has become a worldwide phenomenon, especially in the developed world and its environs. The growing consumption of land, as a result of the extension of highway networks in urban areas, seems to have become an unstoppable cancer and affects virtually all the contemporary metropolis worldwide.

The expansion of the cities had its origin in the model of suburban life began with the generalized use of the car. A lifestyle based on the "American Dream: one single family-home, and one (or more) car (s)", that means mobility and homeownership. However it has been since the late 70s when it has had a more dramatic development, as a consequence of the crisis of metropolitan areas linked to what is called Post-Fordism economy and some authors have characterized as counter-urbanization (Berry) desurbanization (Berg), edge-cities (Garreau) metapolis (Asher)

[4] The literature has discussed deeply the concept of sprawl. For example, Ewing, Pendall & Chen (2002) have defined sprawl "as the process in which the spread of development across the landscape far outpaces population growth. The landscape sprawl creates has four dimensions: a population that is widely dispersed in low density development; rigidly separated homes, shops, and workplaces, a network of roads marked by huge blocks and poor access, and a lack of well-defined, Thriving activity centers , such as downtowns and town centers. Most of the other features usually associated with sprawl-the lack of transportation choices, relative uniformity of housing options or the difficulty of walking-are a result of these conditions."

or diffuse city (Indovina). Despite the diversity of urban development, the increasing consumption of land, the excessive use of land as a scarce resource, it is a constant in the urbanization process in the early twenty-first century.

2. - The origins of urban sprawl.

The low density and diffuse forms of urbanization have their origin in the improvement of urban transport systems that emerged throughout the nineteenth century. The appearance of subways was especially a key element that led to the gradual separation of residential and work, causing the incipient process of suburbanization that took place during the last third of the nineteenth century.

As is well known, the generalized use of the car as a way of private transportation in the early decades of the twentieth century reinforced the trend towards the dispersion of the population, generating new forms of suburban development and the construction of the ideal of “mobility and homeownership", which soon spread from the United States to the world.

According with Dematteis (1997), the urban development between the XIX and XX centuries, brought to the western world, the coexistence of two models of expansion:

• In the traditional Mediterranean until the nineteenth century, the city is not beyond the medieval walls. It was until the industrial age when the countryside where colonized by high-density suburbs.

• In northern Europe, the city expands with the “Civita”, the urban landscape replaces the previous rural and recreates them in some of its elements, the garden city emerged as one of the paradigms of urban development of late nineteenth and early twentieth century.

It was up to the last decades of the last century, when the process of urban sprawl has reached high levels, reaching practically the entire planet. The crisis of the so-called "Fordist-Economy", based on the predominance of the industry and its concentration, to an economic system characterized by the dominance of the services and the gradual dispersion of the industrial production processes, has generated new patterns of urbanization characterized not only by the dispersion of residential activities, but also by the progressive suburbanization in the outskirts of the city of economic activity and employment.

The "counter urbanization", reported by Berry (1976), has made presence not only in countries with a longer history of suburban growth, but also in cities characterized by a compact model, as the Latin Mediterranean. In this sense, the majority of authors have recognized the worldwide generalization of the urban sprawl process.

The territorial model has a significant evolution in the recent decades, becoming from an urban continuum model with medium and high densities, to a diffuse and dispersed city, driven by technological innovation processes, separation of functions and finding proximity to nature. This redefinition of the territorial model was based on the new highway and communication networks, and has as a result a dispersed and unsustainable city thus a city with high consumption of land.

Table 1 suggests a clear differentiation of the consumption of land patterns, depending on socio-economic status of the population. Countries with high and middle income tend to sprawl more than low-income countries. For example, if we limit ourselves to urban areas over 500,000 inhabitants, the urban density in the USA (1,100 inhabitants per km2), Australia (950 inhabitants/km2), Canada (1,500 inhabitants/km2) or Western Europe density (3,000 inhabitants/km2) is lower than the density of cities in Russia (5,000 inhabitants/km2), rest of the Americas (6,350 inhabitants/km2), Africa (8,200 inhabitants/km2), China (6,750 inhabitants / km2), India (15,700 inhabitants/km2) or the rest of Asia (8,050 inhabitants/km2).

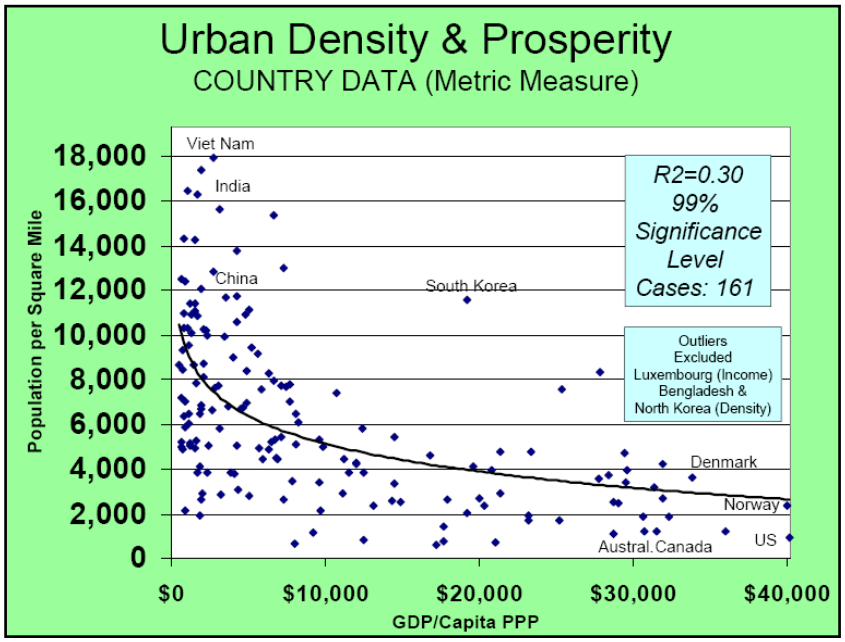
Table nº 1: Population Density of urban areas over 500,000 inhabitants (2007).

Area	Cases	Population (Millions)	Average population per Square Mile of Urban areas	Average population per Square kilometer of urban areas	Density Compared to United States Urban Density
HIGH INCOME WORLD					
Western Europe	61	101.5	7,700	3,000	2.75
Western Europe: Outside UK	51	82.4	7,200	2,750	2.57
Western Europe: UK	10	19.1	10,600	4,100	3.79
United States	65	142.1	2,800	1,100	1.00
Canada	8	14.0	3,900	1,500	1.39
Western Hemisphere Except Canada $	1	2.2	2,500	950	0.89
Australia	5	10.4	3,700	1,450	1.32
New Zealand	1	1.1	5,500	2,100	1.96
Japan	23	79.1	10,700	4,100	3.82
China (Hong Kong & Macao)	1	6.5	76,200	29,400	27.21
China: Taiwan	6	14.9	17,900	6,900	6.39
Asia: Outside China & Japan	21	53.2	17,200	6,650	6.14
Total/average	**192**	**424.9**	**7,800**	**3,000**	**2.79**
MIDDLE AND LOW INCOME WORLD					
Europe Except Russia	29	41.6	10,900	4,200	3.89
China	100	153.4	17,400	6,750	6.21
India	69	134.5	40,600	15,700	14.50
Russia	38	46.6	12,900	5,000	4.61
Asia except China, India & Russia	97	191.7	20,900	8,050	7.46
Africa	81	134.3	21,300	8,200	7.61
South & Central America	101	195.3	16,500	6,350	5.89
Total/Average	**515**	**897.3**	**20,900**	**8,050**	**7.46**
Urban Areas Total: Threshold	**707**	**1,322.3**	**17,400**	**6,700**	**6.21**
WORLD URBAN POPULATION (2002)		**2,985.0**			
Share of World Urban Population in Threshold		**44.3%**			
Urban Areas Below Threshold	595	131.9	8,000	2,050	2.86
TOTAL: ALL LISTED URBAN AREAS	**1,302**	**1,454.2**	**8,700**	**3,350**	**3.11**
Share of world Urban Population		48,7%			

Source: *Demographia World Urban Areas* (2007)

Growing consumption of land, therefore, while being a worldwide phenomenon is concentrated in the developed world and its environs. The graph 1 displays how the countries with high income, with few exceptions, are the geographic areas characterized by higher consumption of land.

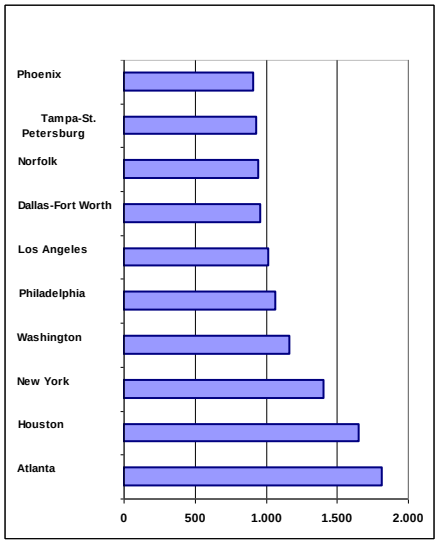
Graph nº 1: Density & Prosperity



Source: *Demographia World Urban Areas* (2007)

In the USA, and if we refer to metropolitan areas (SMA) over one million inhabitants, has grown from a consumption of 161 square miles of land per 1,000 population in 1950 to 243 in 1970 to 293 in 1990. This represented an increase of 384 square miles for every 1,000 new residents between 1950 and 1970, that figure has risen to 527 in the period 1970-1990. The consumption of land has increased since Post-Fordism, reaching its height between 1970 and 1990. Graph 2 shows the fastest growing metropolitan areas between 1970 and 1990.

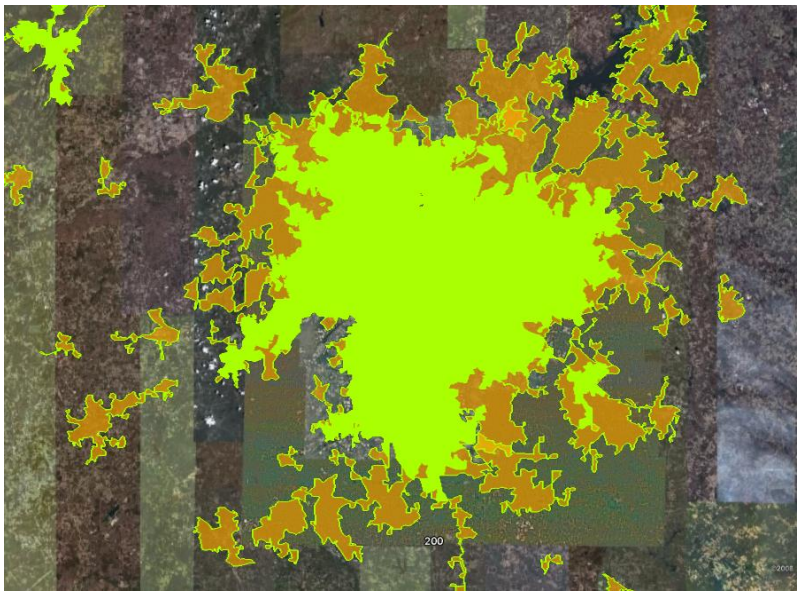
Graph nº 2: Top ten metropolitan areas SMA in consumption of land (1970-1990) (Km²).



Source: Bureau of Census USA

Figure 1 shows the world record of sprawl, the city of Atlanta (in green urbanized land until 1990 and in orange, urbanized land in 2000).

Figure nº 1: Urbanized land in the metropolitan area of Atlanta (1990-2000).



Source: Self prepared from de USA Census Bureau.

The new cities of the developed world, of which Atlanta in the USA is just the most prominent example, showing the endless growth of the urbanized spaces, the car is, almost the only way of transportation and the exponential growth of energy consumption that diffuse cities bring. The environmental unsustainability is therefore inseparable from the urban sprawl. Therefore, agencies and institutions responsible for regulating regional and urban planning are intended to generate alternatives that involve the return to sustainable compactness. The debate on the limits of urban sprawl has led to alternative approaches such as the proposition of the compact city as a new paradigm, the "smart growth" or "new urbanism" in which the control for indiscriminate use of land is one of the fundamental objectives of new urban policies.

3. - The Urban Sprawl in Spain

In Spain there has been an intense increase in the land occupation in the recent decades, due to the highly dynamic process produced by the artificial land uses.

Based on data provided by the CORINE Land Cover project we can say that the artificial land use has increased, in Spain between the years 1990 and 2000, 168,460 ha. This represents a 25.14% of the artificial land at the beginning of this decade.

Comparing with other European countries (see table No. 2), Spain is the most dynamic country in urban expansion, ahead of Germany (158,843 ha), France (122,880 ha) and Italy (82,633 ha). In relative terms, is the third country with the urban growth more pronounced in the studied decade, after Portugal (38.64%) and Ireland (30.67%).

Table nº 2: Artificial land use process in Europe (1991-2000)

	Suelo Urbanizado 1990	Suelo Urbanizado 2.000	Variación 1990-2000	Incremento Suelo Urbanizado	Densidad Población 1990	Densidad Población 2000	Variación Densidad 90-00	Inc. Pob. / Inc SU
AUSTRIA	340.169	350.581	10.412	3,06%	22,90	23,21	0,31	33,39
BELGIUM	607.568	624.433	16.865	2,78%	16,40	16,38	-0,02	15,73
BULGARIA	542.247	545.315	3.068	0,57%	16,12	14,57	-1,55	-259,85
CZECH REPUBLIC	475.904	480.882	4.978	1,05%	21,66	21,23	-0,43	-19,46
GERMANY	2.738.368	2.897.211	158.843	5,80%	29,18	28,44	-0,74	15,63
DENMARK	298.682	311.548	12.866	4,31%	17,25	17,19	-0,07	15,64
ESTONIA	89.562	91.537	1.975	2,21%	17,32	14,88	-2,43	-95,37
SPAIN	669.993	838.453	168.460	25,14%	58,13	48,59	-9,53	10,67
FRANCE	2.538.988	2.661.868	122.880	4,84%	22,47	22,35	-0,12	19,93
GIBRALTAR	294	313	19	6,46%	91,63	88,33	-3,30	37,32
GREECE	254.733	289.934	35.201	13,82%	40,22	37,98	-2,24	21,78
CROATIA	162.433	166.841	4.408	2,71%	28,00	26,96	-1,04	-11,38
HUNGARY	521.543	529.419	7.876	1,51%	19,84	19,25	-0,59	-19,96
IRELAND	104.435	136.468	32.033	30,67%	33,72	28,30	-5,42	10,62
ITALY	1.348.146	1.430.779	82.633	6,13%	42,14	40,44	-1,70	12,65
LITHUANIA	213.320	213.978	658	0,31%	17,35	16,28	-1,07	-331,38
LUXEMBOURG	20.840	22.610	1.770	8,49%	18,54	19,51	0,97	30,94
LATVIA	85.208	85.325	117	0,14%	31,04	27,68	-3,36	-2422,93
NETHERLANDS	370.704	453.827	83.123	22,42%	40,60	35,29	-5,32	11,57
POLAND	1.026.665	1.041.477	14.812	1,44%	37,25	36,86	-0,40	9,42
PORTUGAL	172.916	239.739	66.823	38,64%	57,72	42,90	-14,82	4,55
ROMANIA	1.488.613	1.495.941	7.328	0,49%	15,57	14,73	-0,84	-155,40
SLOVENIA	54.184	54.446	262	0,48%	35,71	36,50	0,79	199,75
SLOVAKIA	276.169	276.522	353	0,13%	19,12	19,48	0,37	306,21
SAN MARINO	625	698	73	11,68%	39,14	39,41	0,27	41,73
UNITED KINGDOM	1.783.646	1.817.051	33.405	1,87%	32,17	32,53	0,36	51,92

By provinces and autonomous regions, the land consumption has been different. In absolute terms, first of all is the growth in Madrid (29,789 Ha) and Valencia (29,308 ha), well ahead of Andalucia (19,652 Ha), Castilla-Leon (16,635 Ha), Catalonia (13,250 Ha), Castilla-La Mancha (12,834 Ha), Murcia (10,143 ha) and other regions. Meanwhile, by

provinces, besides Madrid, Alicante has grown (15,697 Ha), Murcia, Valencia (9,699 ha) and the Balearic Islands (8,140 ha).

In relative terms, the geography of urban growth has affected mainly the region of Murcia (52.63%), Navarre (50.96%), Madrid (49.09%), Valencia (47, 65%) and Balearic Islands (42.75%), compared to Canary Islands (8.43), Catalonia (10.84%) and Galicia (12.66%), which have experienced a content smart growth.

The expansion of urbanization has occurred, if we leave aside the exceptions of Navarre and Madrid, on the Mediterranean coast (with the exception of Catalonia and Andalucia). So out as the provinces with the highest relative growth Alicante (59.90%), Castellon (59.83%), and two districts near Murcia which have grown higher. In the rest of Spain and the cases of Navarre and Madrid already mentioned, there is to highlight the relative growth in some provinces of the two Castillas, like Soria (60.17%), Leon (44.56%), Salamanca (42.22%), Guadalajara (41.60%) and Valladolid (40.68%). It is also noteworthy for Ourense, with a relative growth of 42.51%, well above the other provinces of Galicia. The Provinces with less dynamic urban growth in the decade 1990-2000 have been Teruel (5.35%), Palmas (6.29%), Girona (6.84%), Almeria (7.41%), Pontevedra (7.90%), Corunna (8.88%), Guipuzcoa (9.71%) and Barcelona (10.38%).

In particular, the Center for Land Policy and Valuations of the UPC has studied urban growth produced by a group of Spanish urban areas between 1956 and 2006[5], specifically the urban areas of Barcelona, Madrid, Cordoba, Murcia and the coast of Alicante. In these five areas the population has doubled in the period studied, but more important is that the land consumed by urbanization has grown much more pronounced: a 258%. A total of 673 km2 urbanized, of which 320 has been developed in Madrid area, 126 to the coast of Alicante, 98 to the coast of Murcia, 72 at the Barcelona metropolitan area and 57 km2 in the municipality of Cordoba.

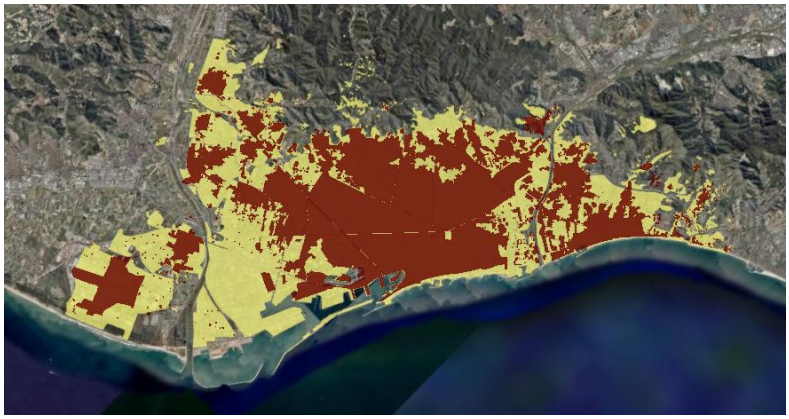
The consumption of land per 1,000 inhabitants has increased in these five urban "landscapes" 6.31 ha in 1956 to 9.19 in 1990 and 11.04 in 2006.

[5] This work, made to the Ministerio de Vivienda, which analysis the urbanization process in the period between 1956 and 2006 in twenty "landscapes" representing the city's urban geography throughout the country and of which five are presented in this paper are a first step. The results of this work have been presented in the 5 x 50 Exhibition, held in April 2007 in Madrid.

This has represented, if considers only the increase of land use in relation to the balance of population, between 1956 and 1990 by 1,000 new residents was a consumption of 12.48 Ha of land (compared with 6.31). This ratio of land consumption increased between 1990 and 2006, reaching 35.37 Ha per 1,000 new inhabitants.
I.e. in the last 15 years there has been a relative increase in land consumption (per person per year), three times higher than in the first 35 years studied. The sprawl is therefore a pathological condition in contemporary Spain.

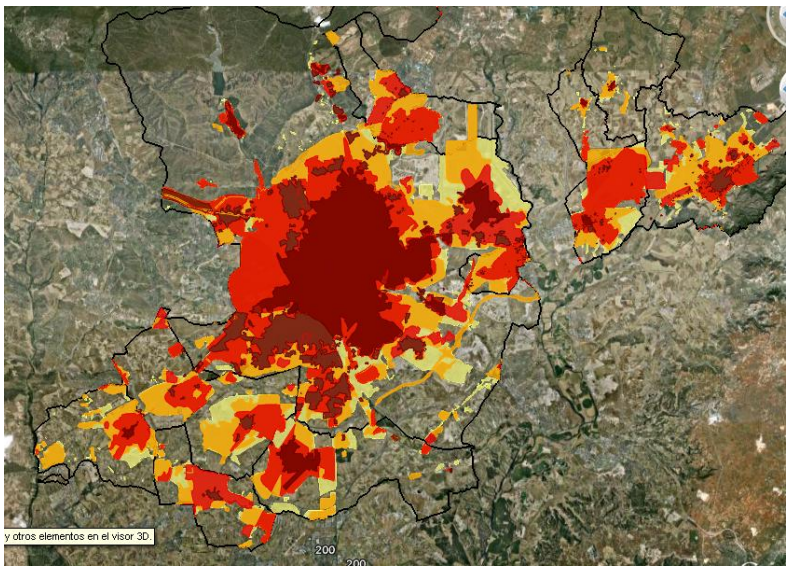
For urban areas, as maximum exponent of the model might be called the compact city, we found the metropolitan area of Barcelona, whose per capita consumption of land has been maintained throughout the past 50 years into moderate level. This has gone from a consumption of 4.84 ha per 1,000 inhabitants to 6.11 in 2006. More moderate than the increases experienced by the agglomeration of Madrid (10.15 in 2006 versus 7.27 in 1956).

Figure nº 2: Barcelona urban growth evolution (1956-2006)



Source: CPSV

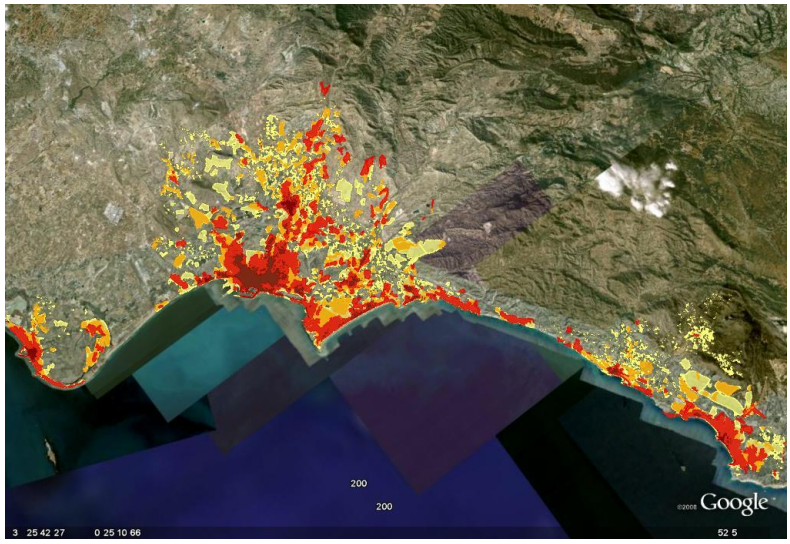
Figure nº 3: Madrid urban growth evolution (1956-1990-2000-2006)



Source: CPSV

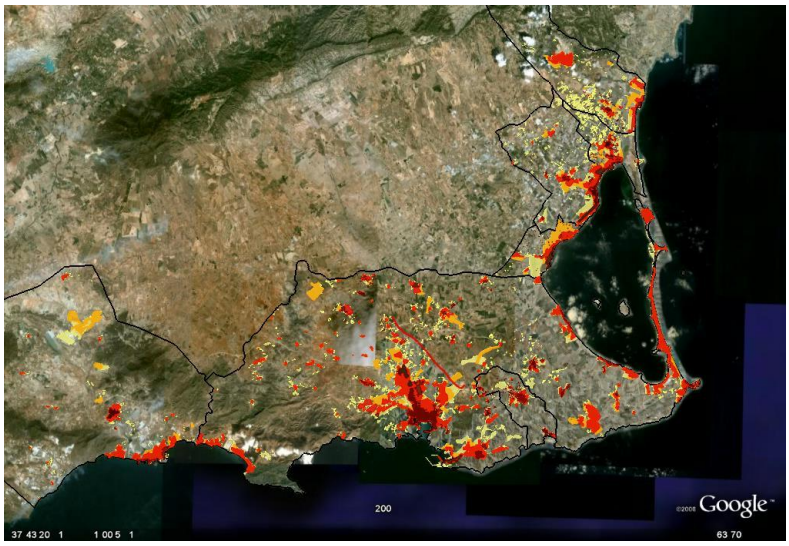
In the opposite direction to Barcelona, there is the large sprawl of Cordoba (20.31 versus 4.92), Costa de Alicante (21.61 versus 9.30) and, above all, Murcia (34.16 vs. 9, 16). The urban sprawl spreads primarily by the Mediterranean coast, but is not exclusive monopoly of it, as evidenced by the high sprawl in an intermediate city as Cordoba.

Figure nº 4: Coast of Alicante urban growth evolution (1956-1990-2000-2006)



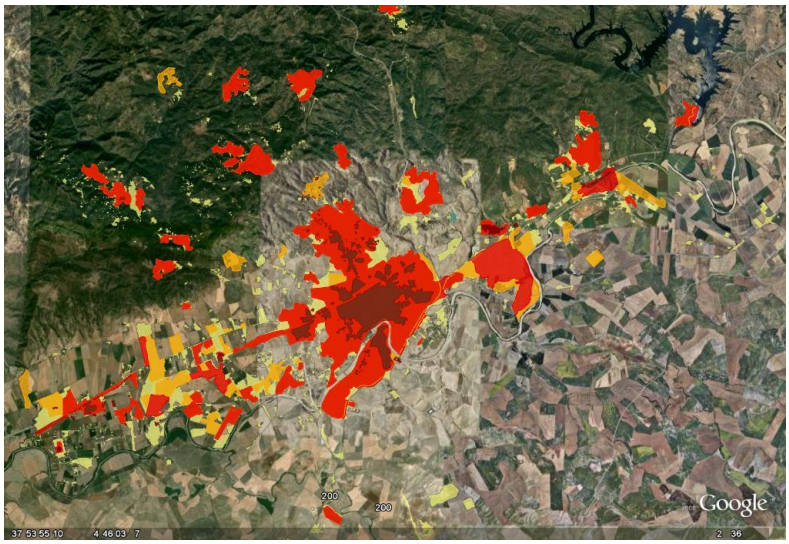
Source: CPSV

Figure nº 5: Coast of Murcia urban growth evolution (1956-1990-2000-2006)



Source: CPSV

Figure nº 6: Cordoba urban growth evolution (1956-1990-2000-2006)



Source: CPSV

The analysis of the urbanization process occurred in Spain between 1956 and 2006 suggests, therefore, the coexistence of two opposing models of urbanization. On one hand, the maintenance of the compact city, as shown in the example of Barcelona, where the emphasis is on the revitalization of the built up area rather than mass consumption of new land for urbanization. On the other hand, the model of the city dispersed

the paradigmatic examples of the Mediterranean coast, where low density and extensive land use are linked to a speculative real estate development.

Consider two models more precisely:

- In the metropolitan area of Barcelona (RMB), an example of compact city, the urbanized land increased between 1990 and 2000, 5875 ha., (9.9%). As the population increased by just 2.9%, a first approximation would suggest that sprawl has also polluted the most compact in this decade. But if you look at the growth of households, who are the truly applicants for urbanized land, the above conclusion is not so obvious: the main housing units increased by 246,847 between 90 and 00, 18.1% more than the increase in urbanized land. In turn, the workplaces, also applicants of urban space, grew by 16.8%, also more than the artificial land. Therefore, in the period 1990-2000, land-use per household fell from 201.5 m2 to 188.6 m2. The sprawl was lower in the decade studied in Barcelona!

- Choosing the Alicante province as an example of a dispersed city, the urbanized land grew by 18,198 ha. in this decade, a 64.7% of the existing in 1990. The population increased by 13.1%, household 30.9% and 52.8% of jobs. And the consumption of land per applicant household- employment rose from 360.2 m2 in 1990 to 418.7 m2 in 2000. As shown, the growth of jobs and homes did not offset the increase in urbanized land, so we can say there was a real process of sprawl in the studied decade. Alicante consumes more than double urban land per household in Barcelona!

Both models, therefore, have distinct behaviors. While the first processes are occurring to the permanence of the compact as one of the guiding elements of urban policy, in the second stated goal of maximum development towards an unsustainable urbanization, in which consumption of natural resources as land and energy appears as distinctive features. This dual trend towards maintaining the compactness and to the dispersion of urbanization, characterized the urbanization process now in Spain.

4. - The Urban Sprawl in Mexico.

In the case of Mexico, as in Spain, is in the second half of last century that cities have experienced higher growth, so from 12 metropolitan areas in 1960 (Unikel, 1978) to a total of 56 in 2005, which account for 56% of the national population, 78.6% of the national urban population and 75% of gross domestic product (SEDESOL, CONAPO and INEGI, 2008).

Table nº 3: Metropolitan Areas Indicators in Mexico (1960-2005)

Indicator	1960	1980	1990	2000	2005
Metropolitan areas	**12**	**26**	**37**	**55**	
Delegations and metropolitan Municipalities	64	**131**	**155**	**309**	**345**
Federative entities	**14**	**20**	**26**	**29**	**29**
Total population (million)	**9.0**	**26.1**	**31.5**	**51.5**	**57.9**
Percentage of national population	**25.6**	**39.1**	**38.8**	**52.8**	**56.0**
Percentage of urban population	**66.3**	**71.1**	**67.5**	**77.3**	**78.6**

Source: Delimitación de las Zonas Metropolitanas de México 2005. SEDESOL, CONAPO e INEGI.

Our analysis is focused in the urban sprawl in the nine metropolitan areas over one million inhabitants in 2000: Valle de Mexico, Guadalajara, Monterrey, Puebla-Tlaxcala, Toluca, Tijuana, Leon, Juarez and La Laguna. These nine metropolitan areas concentrated a 35.4% of the total national population.

Table nº 4: Population Growth in MA (1990-2005)

Range	Metropolitan Areas	Population				The annual average growth rate (%)		
		1990	1995	2000	2005	1990-1995	1995-2000	2000-2005
National Total		81 249 645	91 158 290	97 483 412	103 263 388	2.1	1.6	1
Total Metropolitan Areas	56	42 554 959	49 119 422	53 293 293	57 878 905	2.6	1.9	1.5
1 000 000 or more inhabitants	9	27 489 970	31 414 813	34 009 175	36 601 562	2.4	1.9	1.3
500 000 - 999 999 inhabitants	18	9 110 635	10 888 247	12 022 172	13 456 460	3.2	2.3	2
Less than 500 000 inhabitants	29	5 954 354	6 816 362	7 261 946	7 820 883	2.4	1.5	1.3
Rest of the Country		38 694 686	42 038 868	44 190 119	45 384 483	1.5	1.2	0.5

Source: Delimitación de las Zonas Metropolitanas de México 2005. SEDESOL, CONAPO e INEGI.

In absolute growth in the five years from 2000 to 2005, the greatest increase in consumption of urban land has been the metropolitan area of Puebla-Tlaxcala (17,448.61 ha.), followed by the metropolitan area Valle de Mexico (10,997 ha.).

It is relevant, that especially in the case of Puebla-Tlaxcala, and the Metropolitan Area of Mexico City, in addition to the sprawl, these areas have had a "metropolitanización". That means, metropolitan area Puebla-

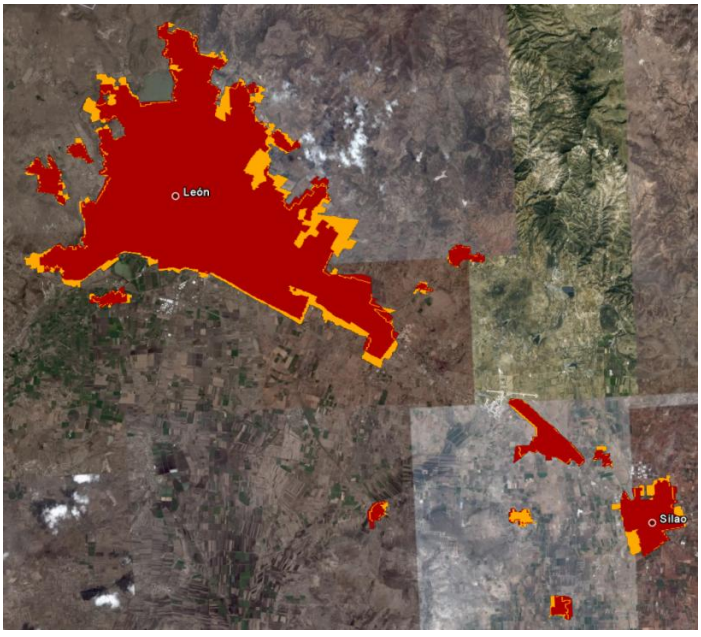
Tlaxcala has joined 15 municipalities in the studied time and ZM Valle de Mexico has added to its surface 24 municipalities of Estado de Mexico.

Monterrey has filed a consumption of land of 7,611.62 ha in the same time and Guadalajara 4,830.89 ha. It also highlighted the growth in the Tijuana area (3,887.66 ha). The cities with less consumption of land of the nine MA's was Toluca (2633.25), La Laguna (2988.37 has.), Leon (3075.78) and Juarez (3134.55).

Table nº 5: Population & Land Consumption in MA (2000-2005)

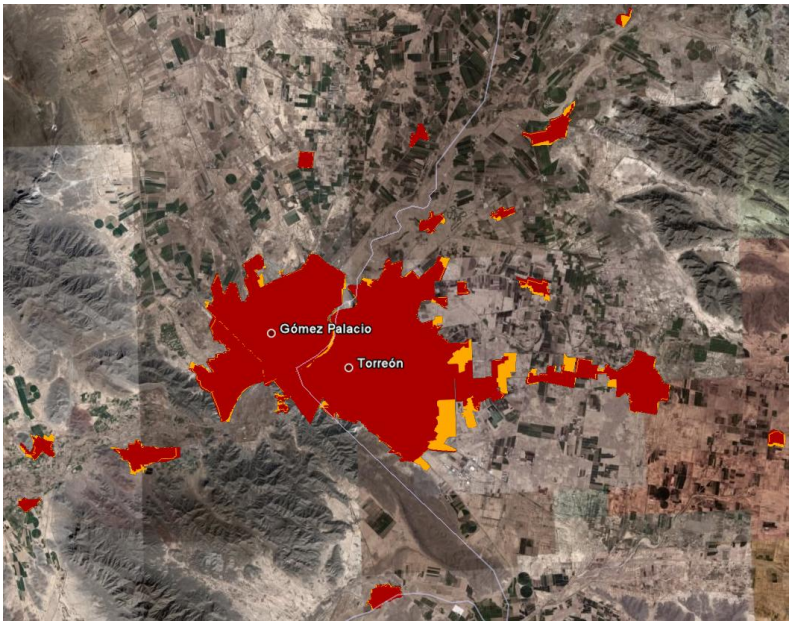
Metropolitan Area	POB_00	POB_05	DIF. POB	SUE_URB_00	SUE_URB_05	DIF. SU	Increase
ZM De la Laguna	1,007,291	1,110,890	103,599	21,226.99	24,215.36	2,988.37	14.08%
ZM Guadalajara	3,699,136	4,095,853	396,717	50,067.80	54,898.69	4,830.89	9.65%
ZM Juarez	1,218,817	1,313,338	94,521	27,334.53	30,469.08	3,134.55	11.47%
ZM Leon	1,269,179	1,425,210	156,031	16,113.27	19,189.05	3,075.78	19.09%
ZM Monterrey	3,299,302	3,738,077	438,775	63,654.65	71,266.27	7,611.62	11.96%
ZM Puebla-Tlaxcala	1,885,321	2,470,206	584,885	49,834.05	67,282.66	17,448.61	35.01%
ZM Tijuana	1,274,240	1,575,026	300,786	26,879.79	30,767.44	3,887.66	14.46%
ZM Toluca	1,451,801	1,633,052	181,251	33,989.83	36,623.07	2,633.25	7.75%
ZM Valle de Mexico	18,396,677	19,239,910	843,233	211,616.51	222,613.51	10,997.00	5.20%

Figures nº 7: Leon urban growth (2000-2005)



Source: Self prepared with databases from INEGI and CONAPO.

Figures nº 8: De la Laguna urban growth (2000-2005)

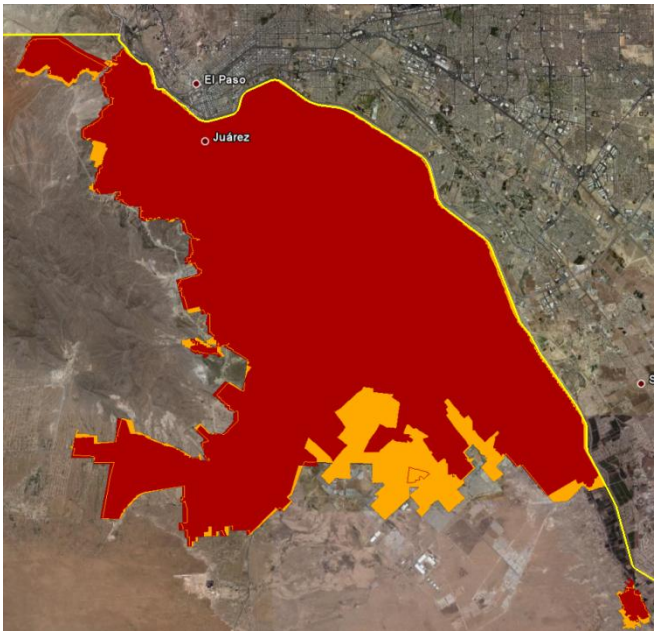


Source: Self prepared with databases from INEGI and CONAPO.

In relative terms, the results vary. The metropolitan area with higher urban growth is again, Puebla-Tlaxcala (35.01%), followed by Leon (19.09%), Tijuana (14.46%) and La Laguna (14.08%). In a second group of high growth were the metropolitan areas of Monterrey (11.96%), Juarez (11.47%) and Guadalajara (9.65%). Finally the regions that have lower urbanization are Toluca (7.75%) and the metropolitan area Valle de Mexico (5.20%).

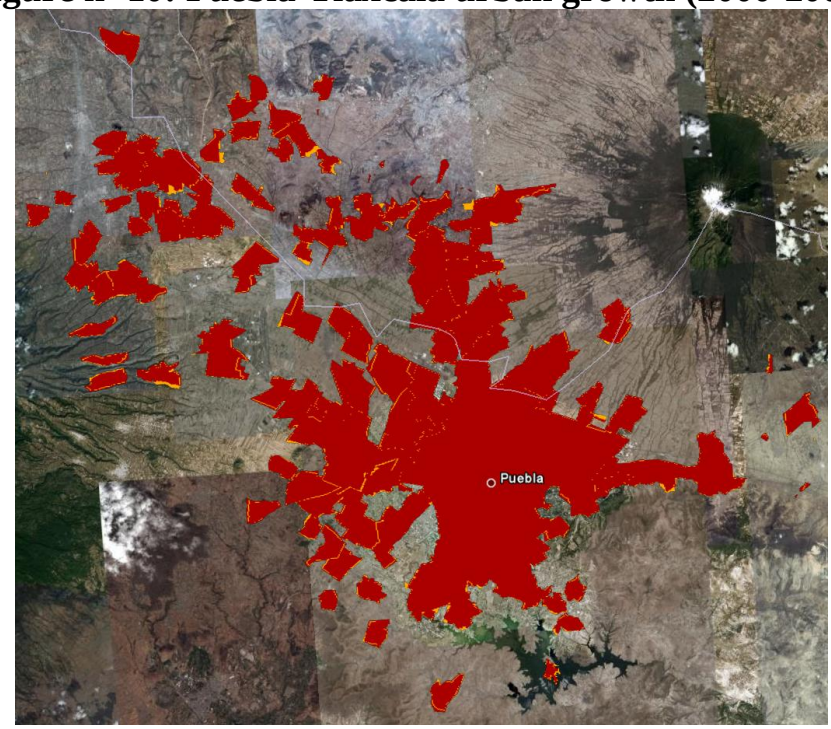
This is explained by the different stages of transformation during de “life” of the cities and their municipalities. On one side we have cities with high global population growth, resulting in high demands for land for housing and new urban centers for trade and services. Such is the case of metropolitan areas of Juarez. On the other side Puebla-Tlaxcala, where the highest growth occurred in the periphery, like in Juarez (14.6%) and San Andres Cholula (6.5%), but the urban growth of this metropolitan area is due too and over all, to the incorporation of 15 municipalities that do not was part of the metropolis in 2000. That does explain the high consumption of land in this short period of time.

Figure nº 9: Juarez Metropolitan Area urban growth (2000-2005)



Source: Self prepared with databases from INEGI and CONAPO.

Figure nº 10: Puebla-Tlaxcala urban growth (2000-2005)

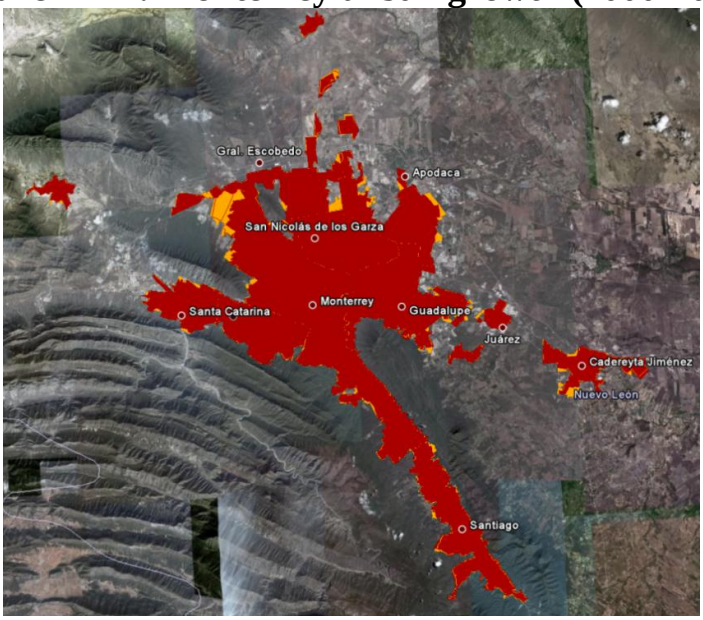


Source: Self prepared with databases from INEGI and CONAPO.

Also, the three largest metropolis of the country are in Absolute Relative Phase of Decentralization. In the case of Guadalajara, with high growth rates in Tlajomulco de Zuñiga (10.8%) and El Salto (5.2%) and negative growth rates in the central city of Guadalajara, losing in absolute numbers 45 thousand inhabitants. The case of the ZM Monterrey with high population growth in

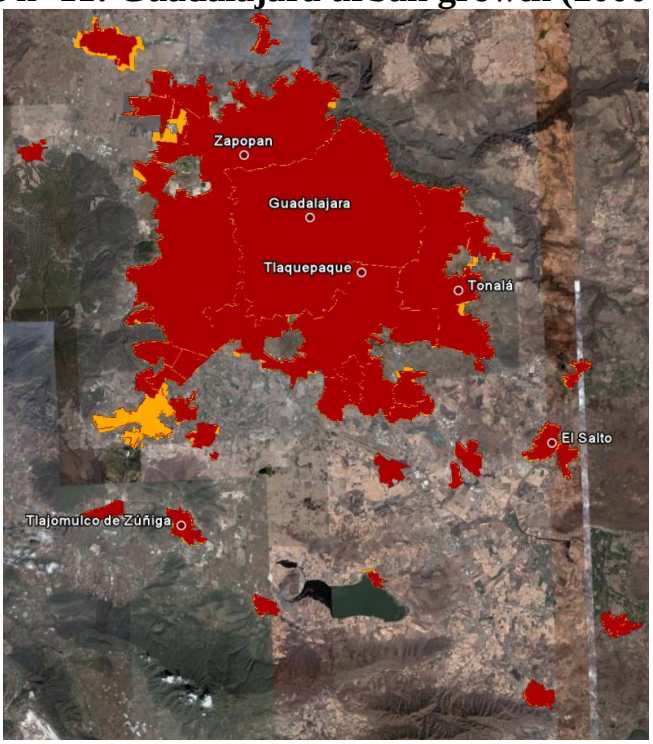
Garcia (10.7%), Apodaca (7.1%) and Salinas Victoria (6.9%) and loss of population in the San Nicolas de Garza (20 thousand inhabitants).

Figure nº 12: Monterrey urban growth (2000-2005)



Source: Self prepared with databases from INEGI and CONAPO.

Figure nº 11: Guadalajara urban growth (2000-2005)

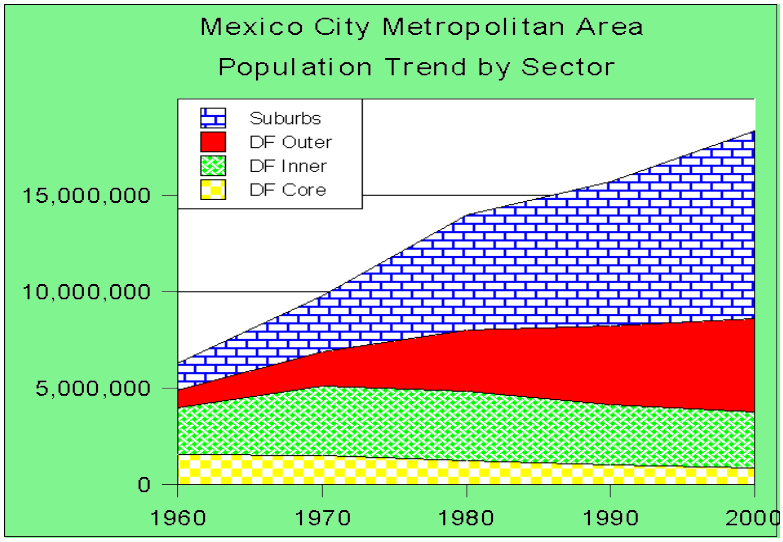


Source: Self prepared with databases from INEGI and CONAPO.

Finally, the case of the Metropolitan Zone Valle de Mexico, won population in Chicoloapan (14.8%), Tecamac (8.2%), Huehuetoca (8.1%), Cuautitlán (6.8%),

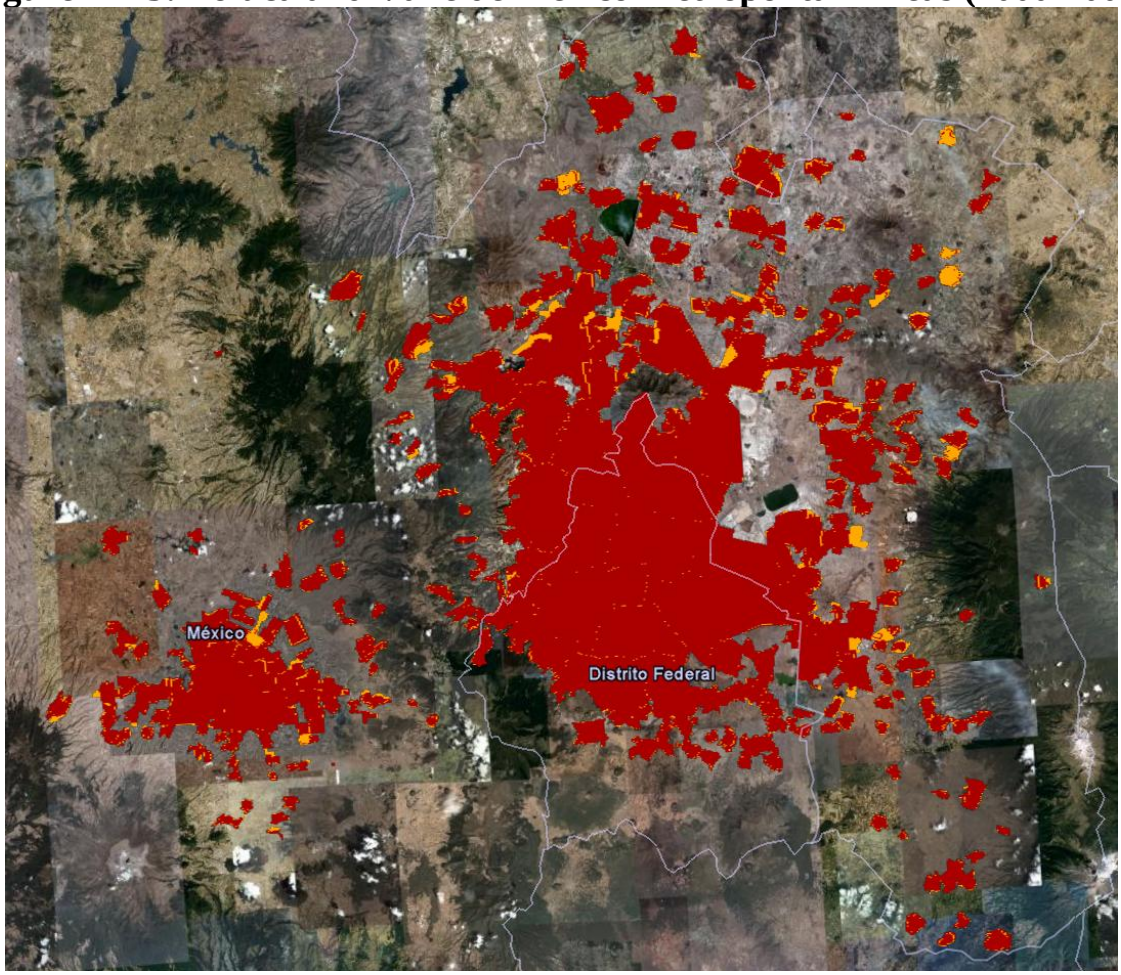
Ixtapaluca (6.7%) and Tezoyuca (5.4 %). The central municipalities and delegations, in absolute terms, have the greatest losses, in which Nezahualcóyotl highlighted (with a loss of 85 thousand inhabitants), Gustavo A. Madero (42 mil), Tlalnepantla (38 mil), Naucalpan (37 thousand), Iztacalco (16 thousand), Azcapotzalco (16 thousand) Venustiano Carranza (15 thousand) and Coyoacán (12 thousand).

Graph nº 3: ZMVM Population Trend by Sector (1960-2000).



Source: *Demographia World Urban Areas*

Figure nº 13: Toluca and Valle de Mexico Metropolitan Areas (2000-2005)



Source: Self prepared with databases from INEGI and CONAPO.

This phenomenon of urbanization has resulted in at least three metropolitan areas which concentrated over one quarter of the total inhabitants of Mexico.

As already mentioned, the urban sprawl has increase in the last decades of the last century, Mexico was no exception. It is also important to mention, the momentum of the housing finance sector in the beginning of this century. In this sense, the INFONAVIT (main source for financing housing) granted in the period 2000 to 2007 136% more than in the previous 27 years of existence of the Institute. This resulted in 2'593,321 mortgages.

However, the growth of this sector has been directed to developments of single-family homes, and low and medium density of vertical and horizontal buildings, and always auto-oriented developments.

The metropolitan area who sprawls more in the period 2000-2005 was Juarez, with a consumption of 33.16 hectares for every thousand inhabitants. And the opposite, the MA who sprawls less was Guadalajara with 12.17 hectares per thousand inhabitants and Tijuana with 12.92.

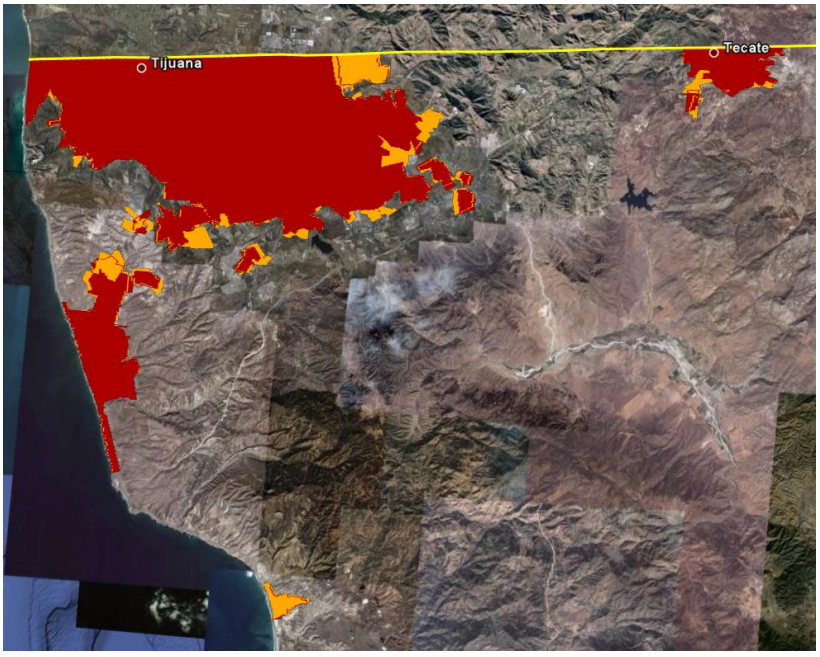
If we analyze the average of urban densities of the nine metropolitan areas, again can be observed the tendency to sprawl, all the MA's have declined in density in this five years, with the exception of Tijuana, whose density has increased slightly from 83.9 inhabitants/ha in 2000 to 85.8 inhabitants/ha in 2005.

Table nº 6: Urban Density in MA (2000-2005)

Metropolitan Area	DMU_00	DMU_05
ZM De la Laguna	87.8	83.3
ZM Guadalajara	137.6	133.2
ZM Juarez	91.1	76.9
ZM Leon	142.2	128.9
ZM Monterrey	120.1	116.6
ZM Puebla-Tlaxcala	93.9	82.5
ZM Tijuana	83.9	85.8
ZM Toluca	67.1	66.8
ZM Valle de Mexico	170.7	166

Source: Self prepared with databases from INEGI and CONAPO.

Figure nº 14: Tijuana Urban Growth (2000-2005)



Source: Self prepared with databases from INEGI and CONAPO.

The sprawl in Mexico is present in all metropolitan areas studied, as a result not only by the high mobility obtained with the generalized use of the car, but also by socio-economic issues.

Among them, there is the preference of developers to locate new housing of low and medium density in the suburbs of the city. This is due mainly to the costs of land. It seems more profitable to buy land at low cost, which is classified as land for future growth or land even outside the city limits, and develop this land bringing high demands of roads, transportation and services, that will be difficult to absorb by governments, thus delaying the consolidation of the city and the development of urban services such as recreation, education, sports or health.

This city model, also generated by the influence of the "American way of life" in Mexico, leads to an unsustainable city, as the dispersion generates environmental, social and economic impacts. Example of this, the high energy and land consumption, the decrease in leisure-time, that redounds in a lower quality of life, and a high demands for urban services and infrastructure.

Another big problem generated by the diffuse city is the public transport, as it requires a large investment to reach all areas of the city, so people must solve their problem of mobility with the use of private cars.

Also, the dispersed city leads in many cases lack of identity and insecurity, which results in the fragmentation of the city. Such is the case of the “gated communities” in all Mexican metropolitan areas which are built for people with middle and high income, and promotes the privatization of public space, in search of safety and quality of public space (neighborhood park and playground basically), excluding the rest of the citizens and without “looking out” and building a city that makes no city.

However, the urban policy in Mexico in the last years is to make cities with sustainable development and to increment the urban densities.

5. Spain and Mexico, two opposite models?

Spain and Mexico (New Spain in the colonial language) took the 8th and 9th place in the ranking of world economies. There are traits, therefore, that make

them similar, but also elements that differentiate them. The per capita income, as the geography and history of both countries make them different.

But talking about the urban sprawl is not very different. Contrary to the hypothesis of income level, Mexico seems to sprawl more. However the trend seems to be to increase greatly in Spain rather than Mexico.

Spain, until now characterized by a compact urbanization, has denoted worrisome trends toward sprawl in recent decades. Between 90 and 00 was the European country with the highest consumption of land.

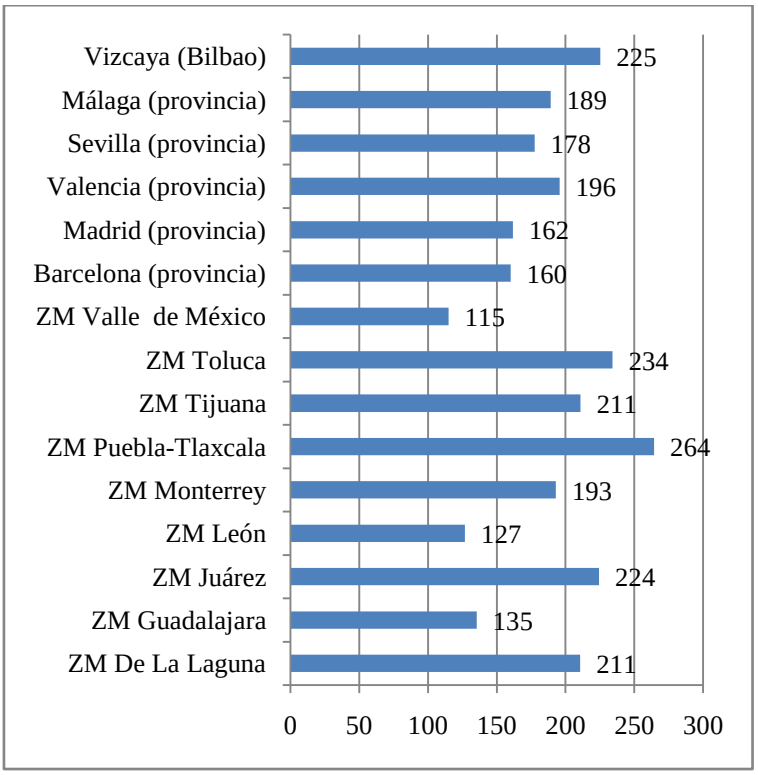
At detail, we can find that there are two contradictory phenomena: the Barcelona and Bilbao "model", which is present the regeneration of the existing urban land and growth is not extensive, compared to the Mediterranean coast "model", which the high dispersion of urbanization is a characteristic.

Diagnosis of Mexico in the years 2000 to 2005 suggests a process of fewer sprawls than in Spain. On the density of population (or per capita consumption of land), the Mexican AM seem denser than Spanish Metropolitan Provinces. Especially in the metropolitan areas of Valle de Mexico, Leon and Guadalajara (see graph number 4).

Table nº 7: Population and Urban Land in Mexico and Spain (2000)

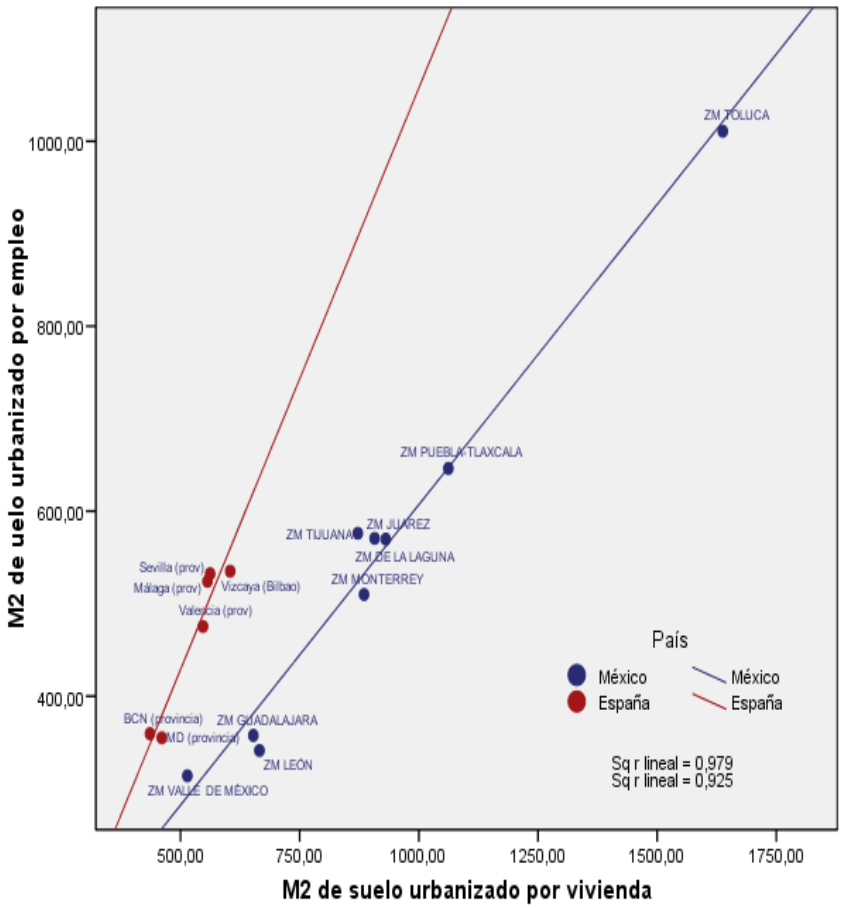
	Metropolitan Area	Pob_00	Sue_Urb_00
México	ZM De La Laguna	1007291	21226.99
	ZM Guadalajara	3699136	50067.80
	ZM Juárez	1218817	27334.53
	ZM León	1269179	16113.27
	ZM Monterrey	3299302	63654.65
	ZM Puebla-Tlaxcala	1885321	49834.05
	ZM Tijuana	1274240	26879.79
	ZM Toluca	1451801	33989.83
	ZM Valle de México	**18396677**	**211616.51**
Spain	Barcelona (province)	4804606	76952.13
	Madrid (province)	**5372433**	**86860.43**
	Valencia (province)	2227170	43574.87
	Sevilla (province)	1747441	31022.83
	Málaga (province)	1302240	24633.04
	Vizcaya (Bilbao)	857565	19313.34

Graph nº 4: Land Consumption (square meters per inhabitant) in Spain and Mexico (2000)



Another hand, if we look to the "real plaintiffs": the consumption of land for housing and employment (lesser extent) suggests that there is more sprawl in Mexico. As we can see in graph number 5, in Mexico there is a greater sprawl of housing and of jobs than in Spain.

Graph nº 5: Urban Land per home and employment (2000)



Finally, we can say that is necessary to assess the appropriateness of design a city more compact, denser and sustainable in order to create cities that "make city" and thus improve the quality of life.

Even though there is too much to study and analyze about the urban sprawl process in both countries, we can say that it seems the regeneration, land recycling, compact and integrated developments, may be are the way to forward.

References:

DEMATTEIS, Giuseppe. *Suburbanización y periurbanización. Ciudades anglosajonas y ciudades latinas.* Dentro de *La ciudad dispersa*. Suburbanización y nuevas periferias. Barcelona: Centro de Cultura Contemporánea de Barcelona, 1998.

EWING, R.., PENDALL, R. & CHEN, D. *Measuring Sprawl and Its Impact*, Smart Growth America, 2002.

MONCLÚS, Javier. *Estrategias urbanísticas y crecimiento suburbano en las ciudades españolas: el caso de Barcelona.* Dentro de *La ciudad dispersa*. Suburbanización y nuevas periferias. Barcelona: Centro de Cultura Contemporánea de Barcelona, 1998.

SALINGAROS, Nikos. *La ciudad compacta sustituye a la dispersión.* Dentro de *La ciudad de baja densidad. Lógicas, gestión y contención*. Por Francesco Indovina. Diputació de Barcelona, España: 2007.

COUCH y Karecha. *Controllig urban sprawl: some experiences from Liverpool.* Published in *Cities*, Volumen 23, No. 5, 353-363. Inglaterra, Octubre 2006.

GALSTER, George, Royce Hanson y Michael R. Ratcliffe. *Wrestling sprawl to the ground: Defining and measuring an elusive concept. Housing Policy Debate*, Volumen 12, Number 4. Fannie Mae Foundation, USA, 2001.

INDOVINA, Francesco. *Algunas consideraciones sobre la ciudad difusa.* Dentro de *Doc. Anál. Geogr.* Número 33. Venecia Italia, 1998.

MARMOLEJO, Carlos y Mariana Stallbohm. *Paisajes en transición, la reconfiguración espacial del uso del suelo en la RMB: ¿Hacia un cambio de paradigma urbanístico?.* Barcelona, España, 2008.

SCHNEIDER, Annemarie y Curtis Woodcock, *Compact, Dispersed, Fragmented, Extensive? A Comparison of Urban Growth in Twenty-five Global Cities using Remotely Sensed Data, Pattern Metrics and Census Information*. Published in Urban Studies, Vol. 45, No. 3, 659, Inglaterra, march 2008.

SEDESOL, CONAPO e INEGI, *Delimitación de las zonas metropolitanas de México 2005*; Edición 2008.

TSAI, Yu *Hsin. Quantifying Urban Form: Compactness versus 'Sprawl'.* Published in *Urban Studies.* Vol. 42, No. 1, 141–161, England, January 2005.